Does Restoration Create Habitat?

Quantifying Instream Habitat Using Two-dimensional Hydrodynamic Analysis

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State of the Science

"River restoration is an increasingly popular management strategy for improving the physical and ecological conditions of degraded urban streams."

Bernhardt and Palmer, 2007

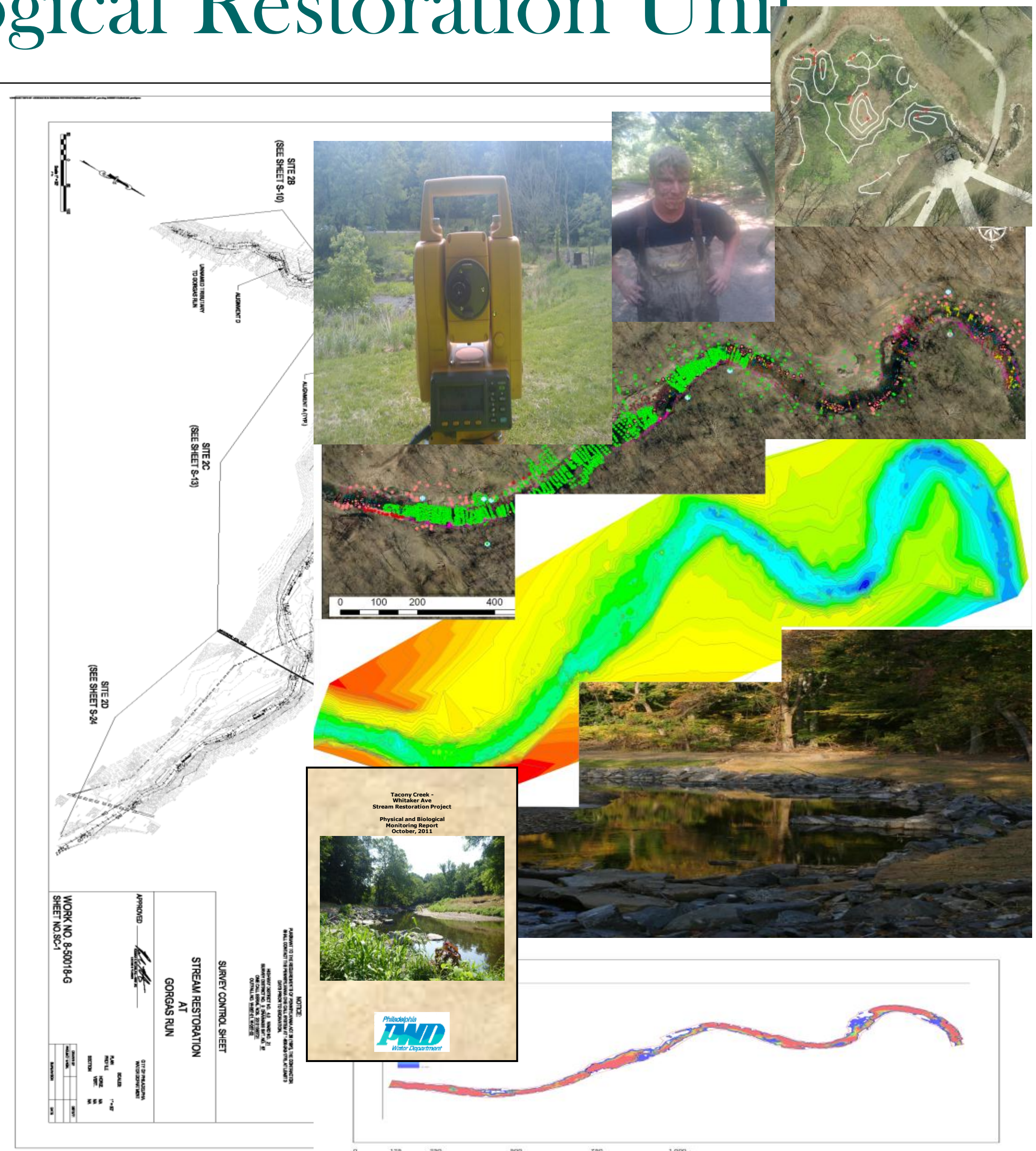
State of the Science

"...stream restorations are implicitly assumed to restore biological diversity, no urban stream restoration to our knowledge demonstrates substantial, long-term biological increase."

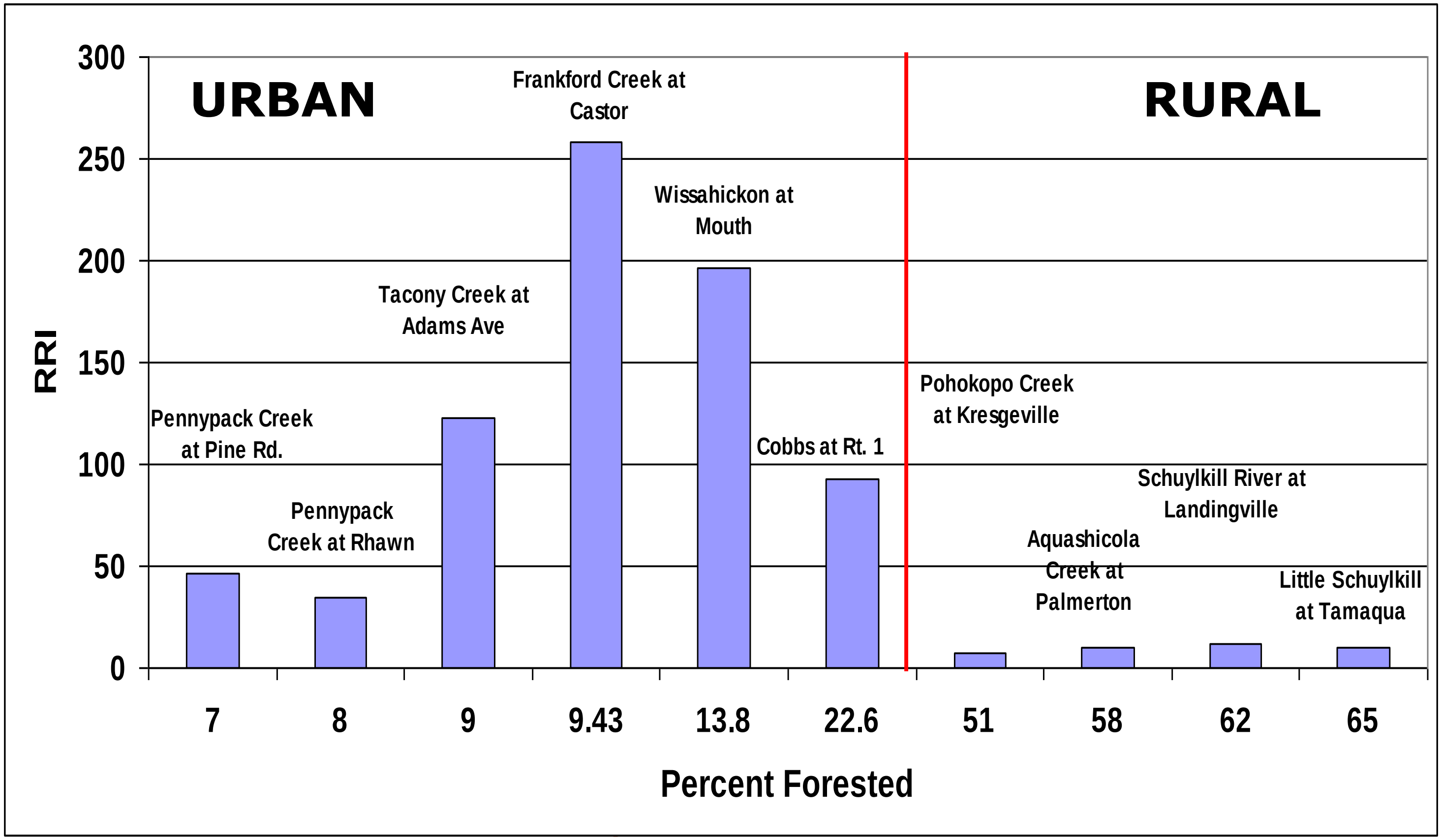
Stranko et. al, 2011

PWD's Ecological Restoration Unit

- Assessment
- Implementat
- Monitoring



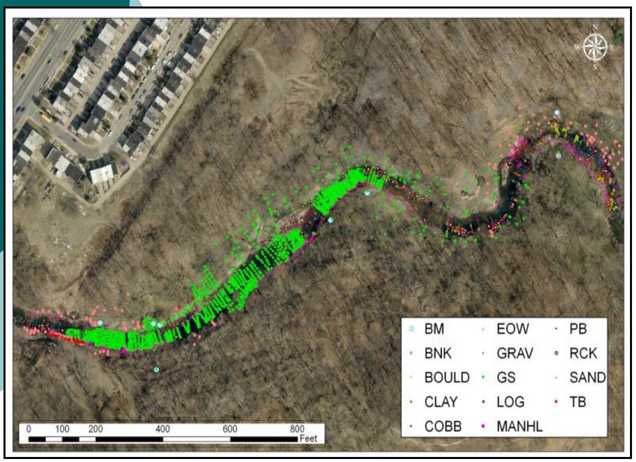
Why is Monitoring Important [to PWD]?

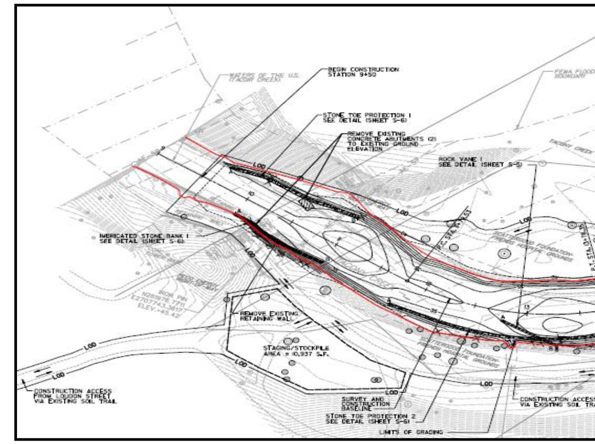


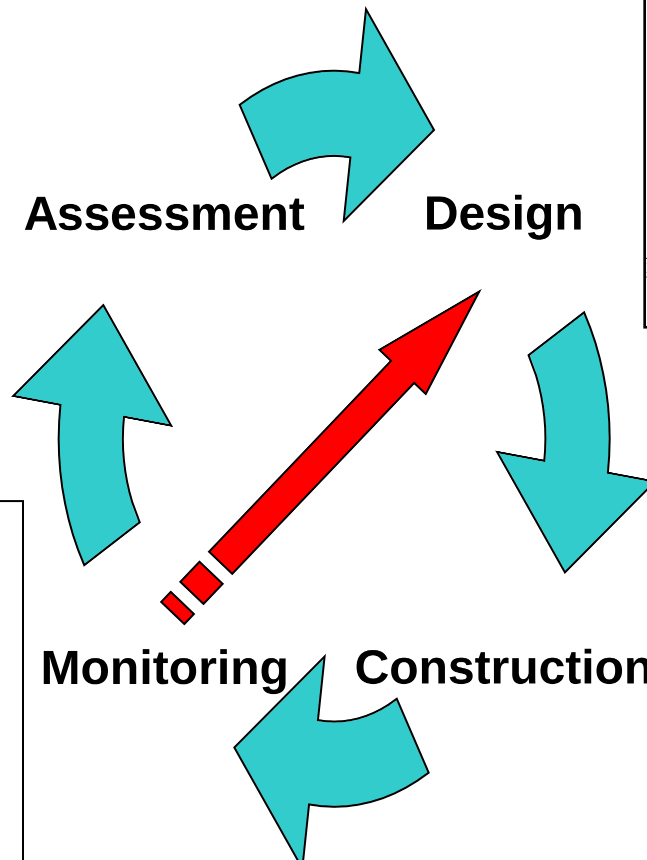
$$RRI = \frac{Q_{1yr}}{Q_{base}}$$

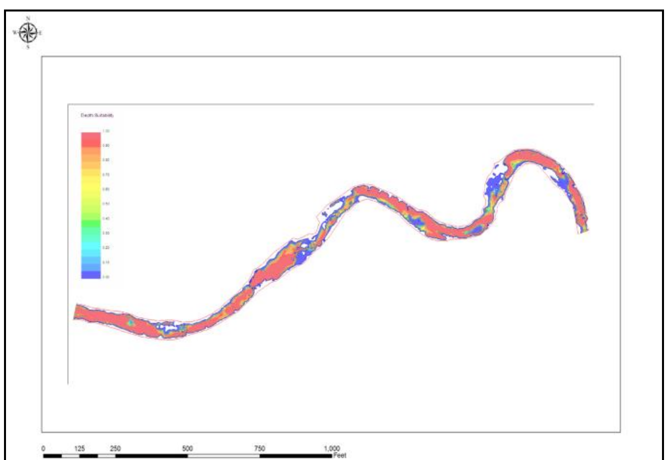
[Photo]Monitoring?

Closing the Loop….









River2D Hydrodynamic Model

- University of Alberta (Steffler and Blackburn, 2003)
- Depth-averaged finite element 2D hydrodynamic model

R2D Model suite:

- River2D_BED
- River2D_MESH
- River2D Hydrodynamic Model
  - **Spatially explicit output…(*e.g.* velocity, depth, Froude #, shear velocity)**
  - **Habitat Evaluation Module**
    - **Customized for evaluation of fish habitat** (PHABSIM)

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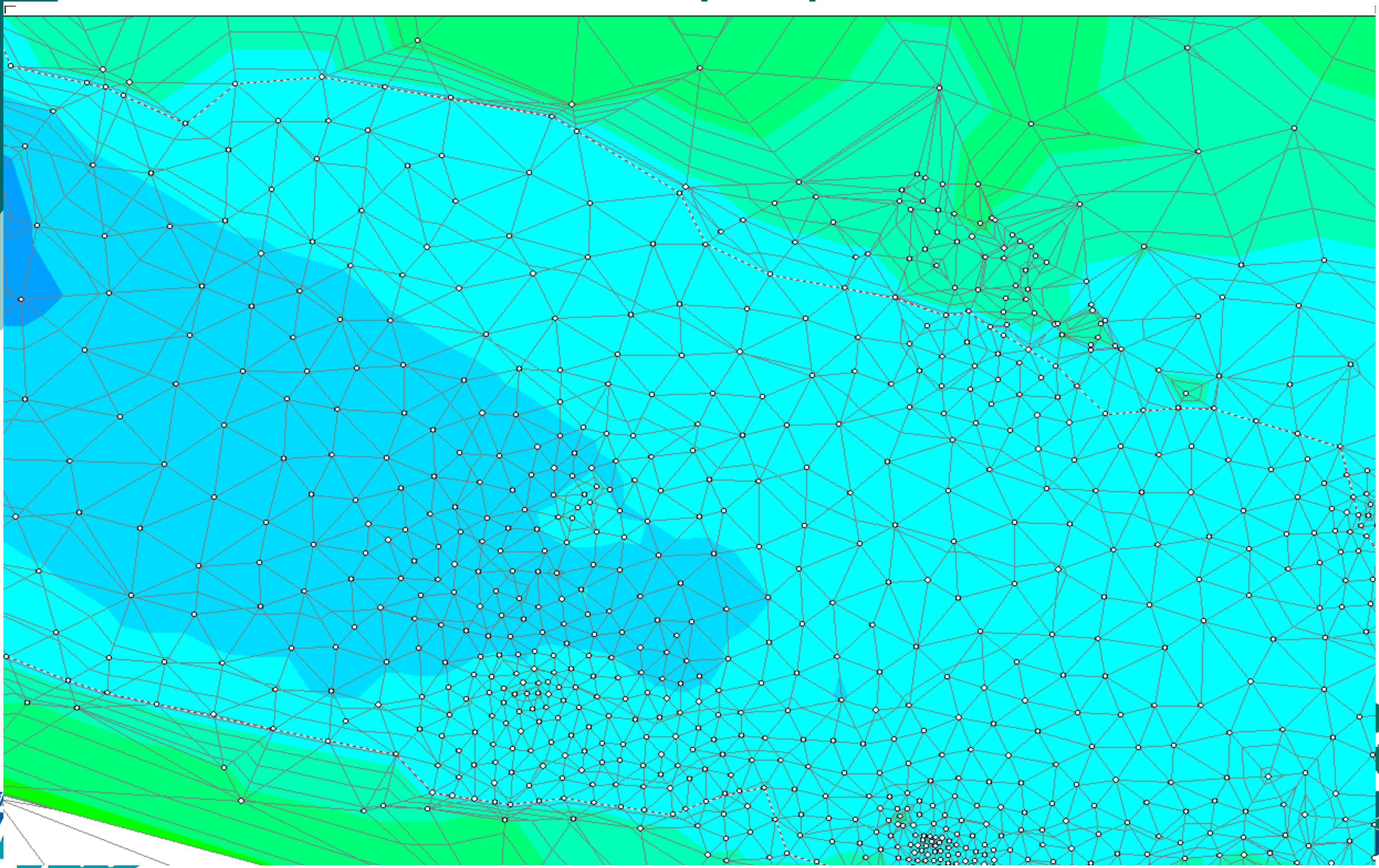
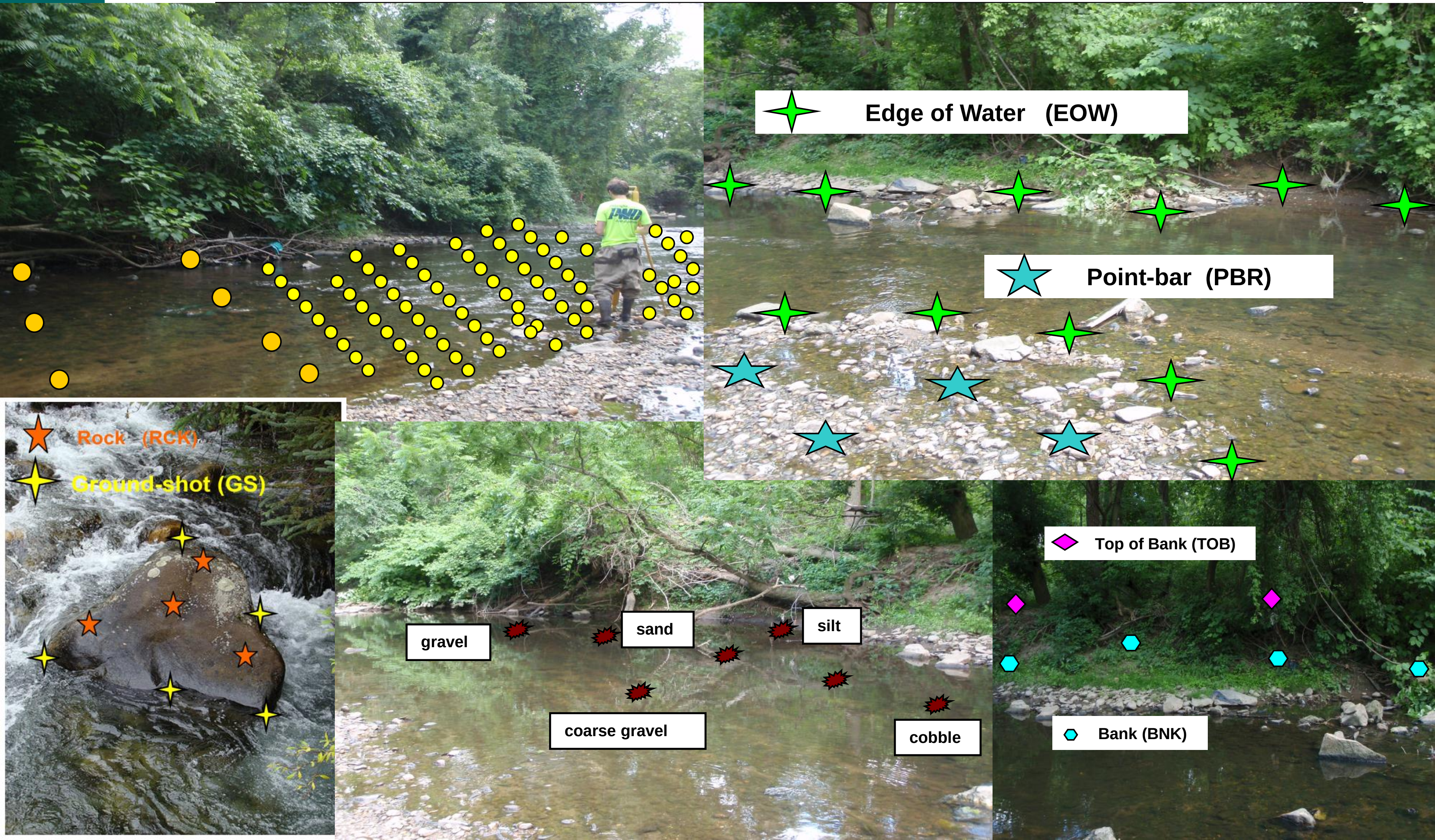
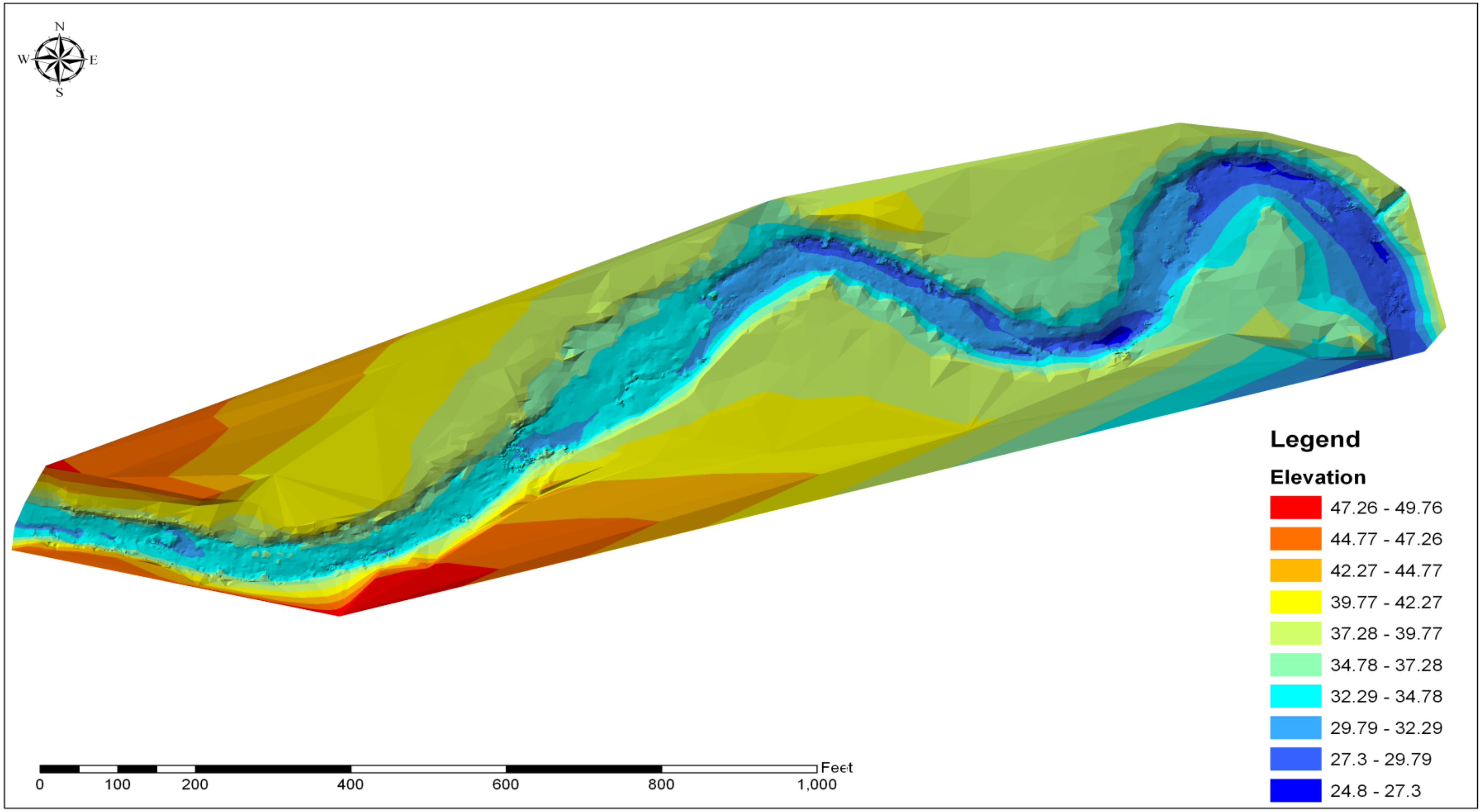
River2D BED preprocessor



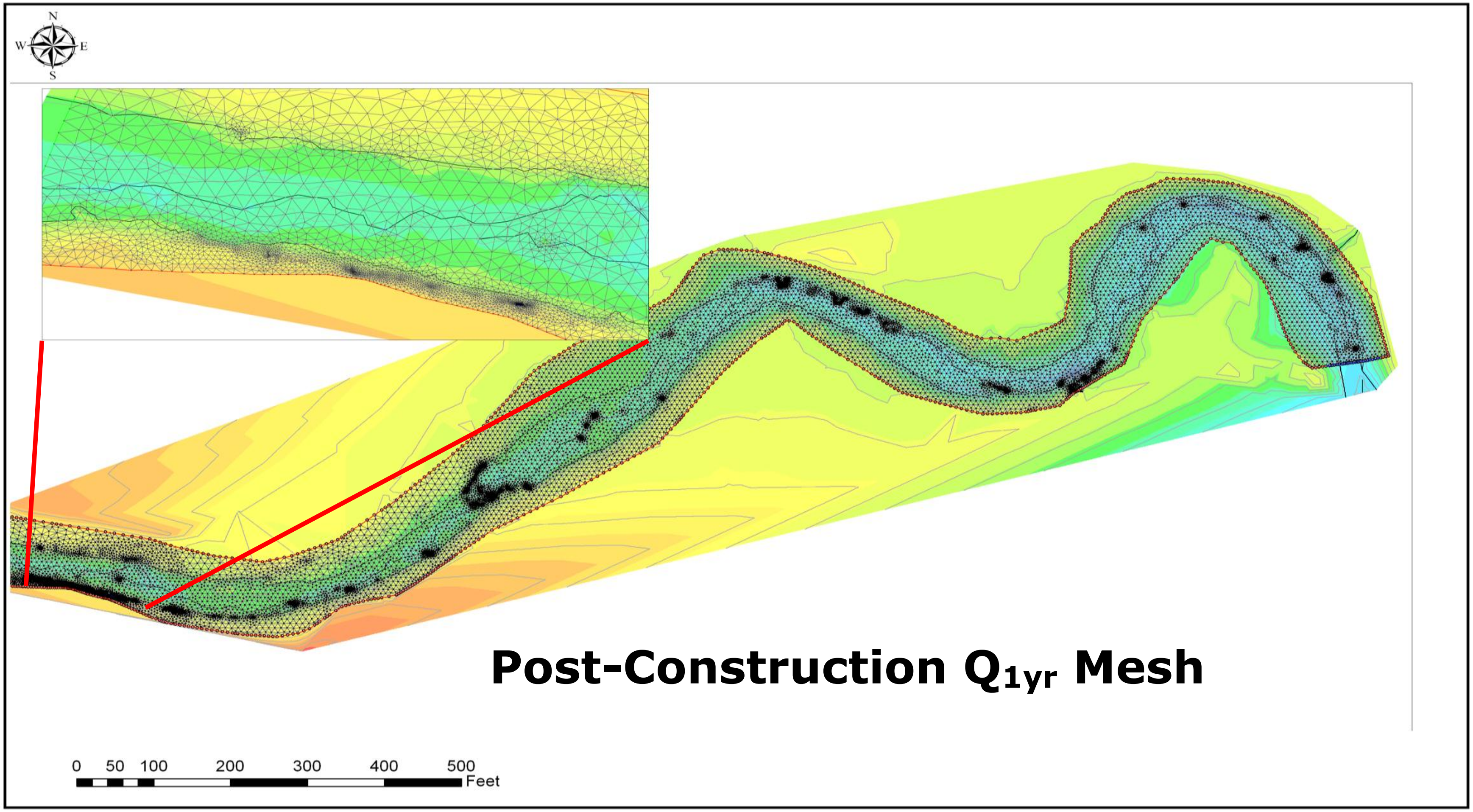
Survey Considerations



Topographic Survey

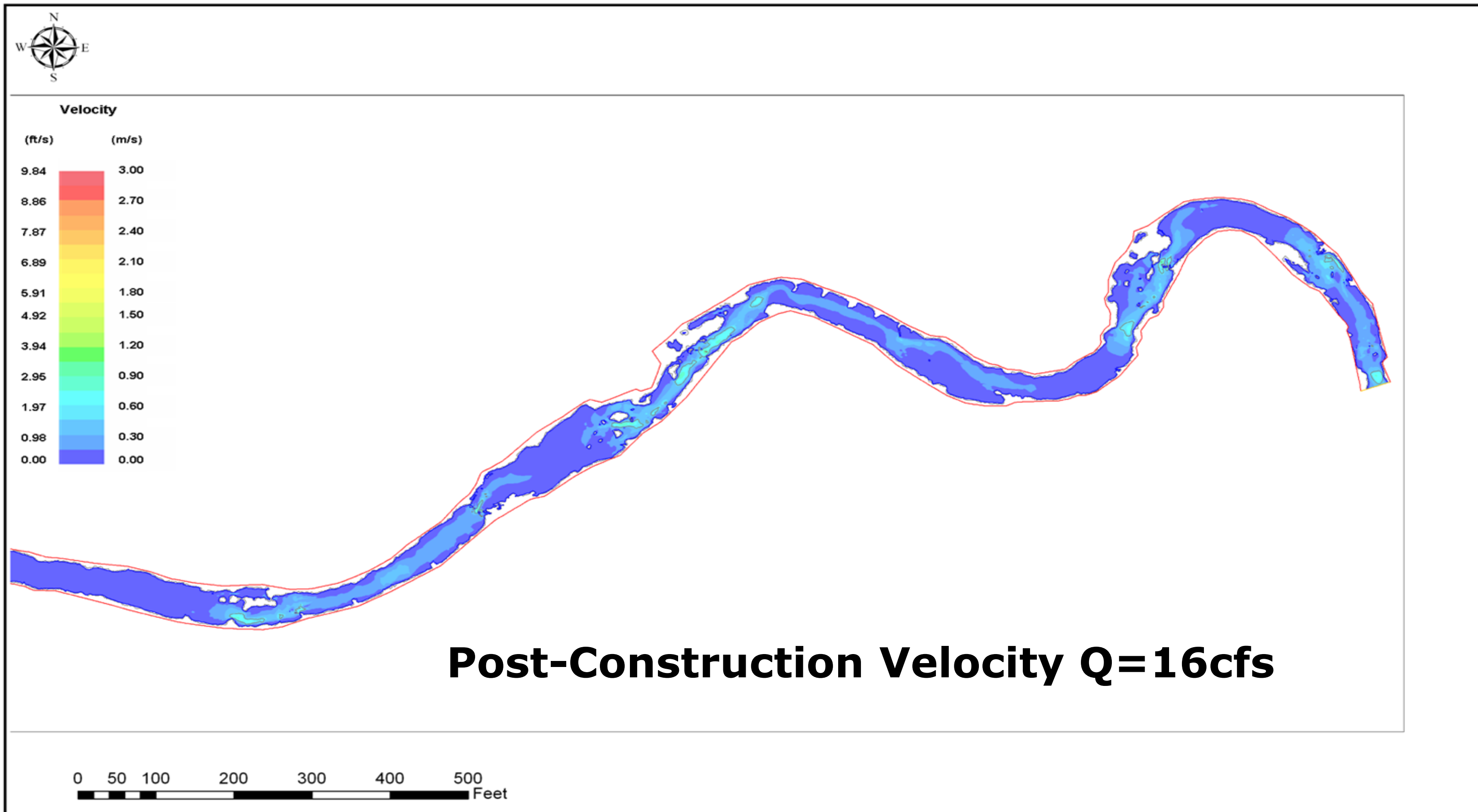


River2D Mesh



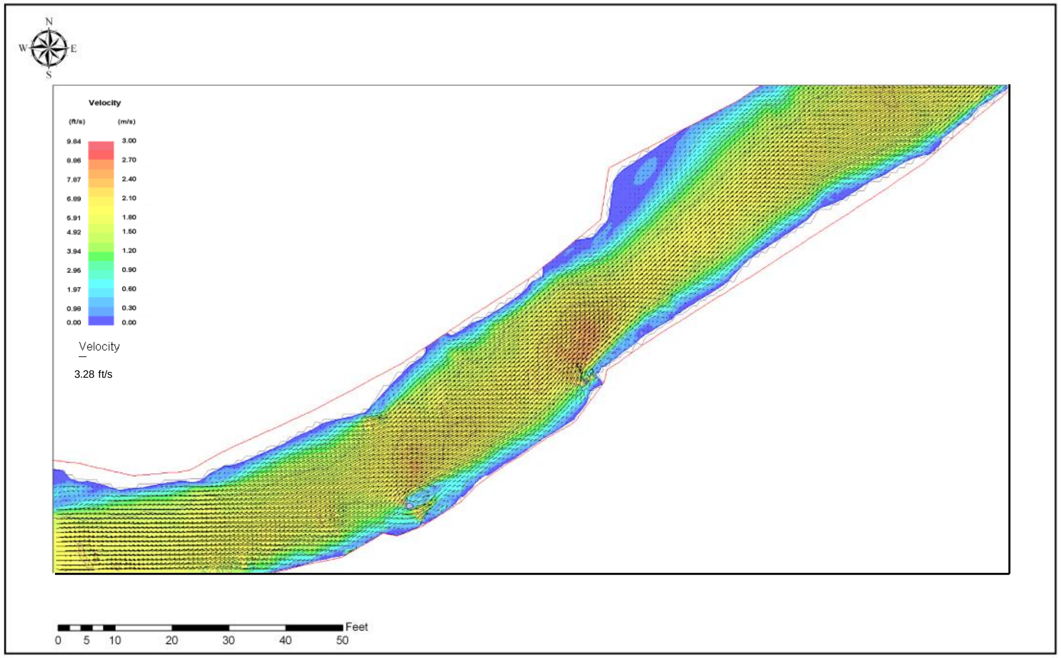
Post-Construction Q_{1yr} Mesh

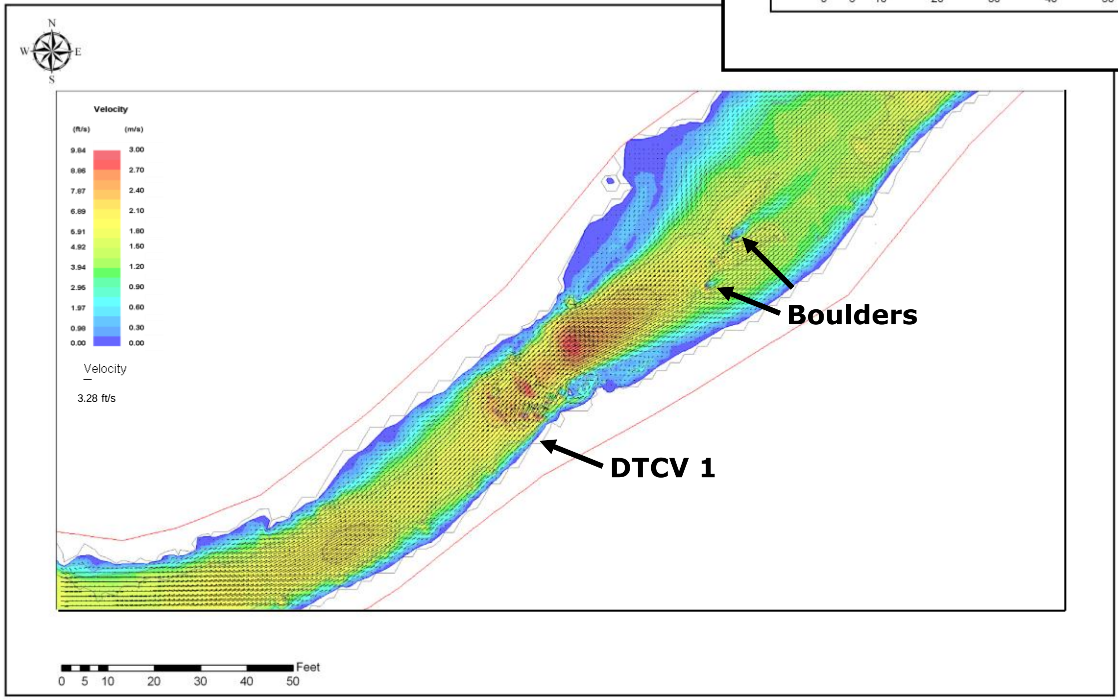
River2D Hydrodynamic Output



Velocity Distribution between Stations 14+00 – 18+00 at the Q1yr Discharge

Pre-Construction →



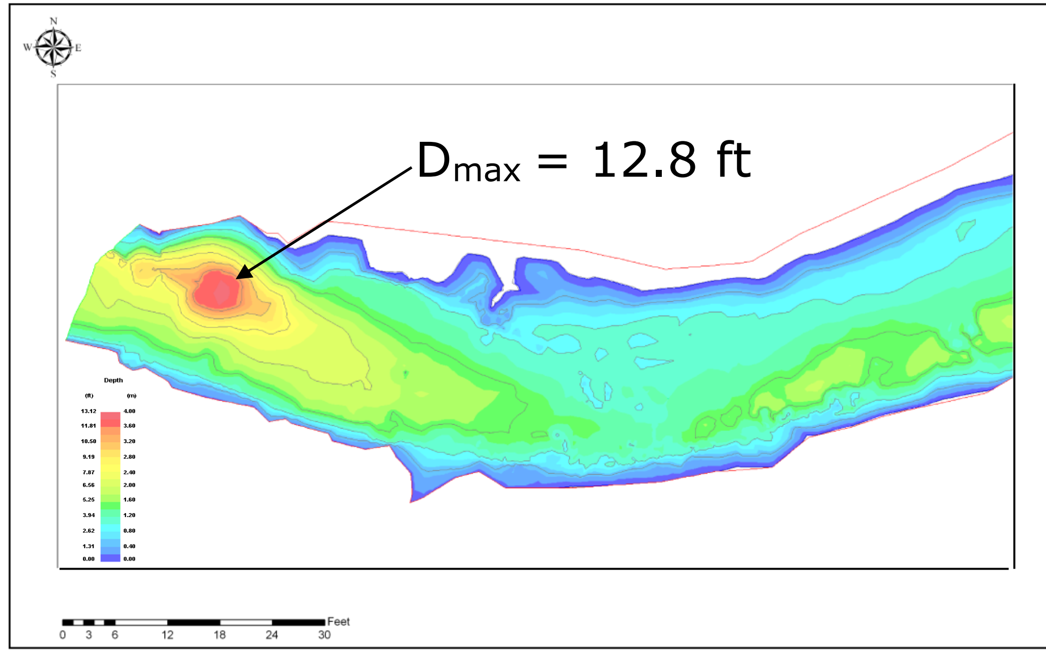


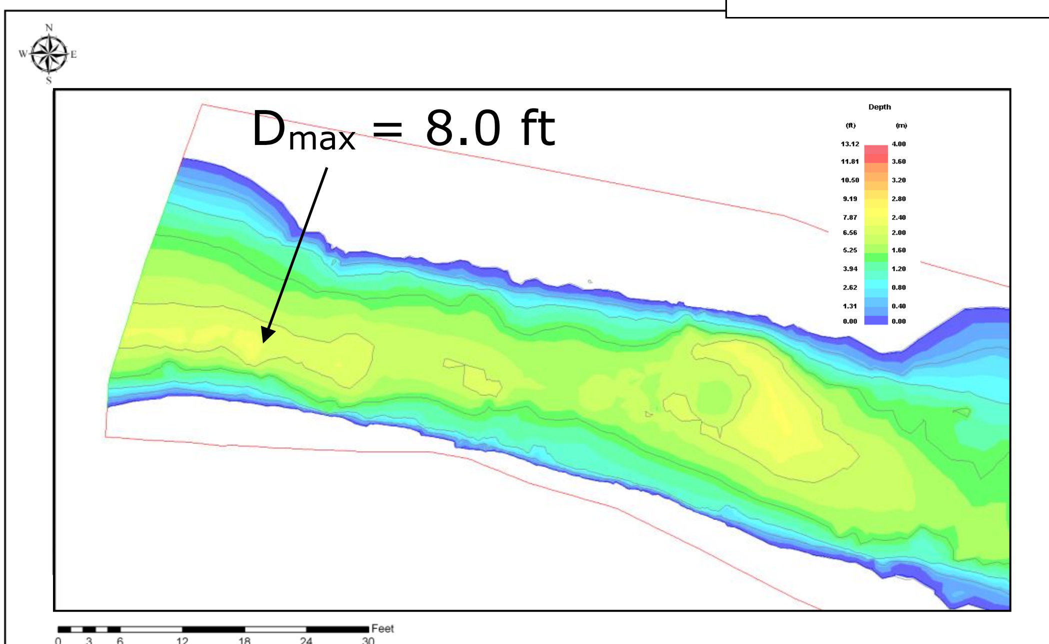
Velocity Distribution between Stations 14+00 – 18+00 at the Q1yr Discharge

← Post-Construction

Depth Distribution between Stations 10+00 – 11+50 at the Q1yr Discharge

Pre-Construction →





Depth Distribution between Stations 10+00 – 11+50 at the Q1yr Discharge

← Post-Construction

River2D Habitat Module

WUA based on species-specific suitability criteria

- Depth
- Velocity
- Substrate

$\Big\}$ HSI

$$WUA = SI_{Depth} \times SI_{Velocity} \times SI_{Substrate} \times Area_{Element}$$

Where: SI = Suitability Index value (0.0 – 1.0)

Hypothetical HSI for 3 "guilds"

- Pool (*e.g.* smallmouth bass, large sunfish)
- Riffle (*e.g.* margined madtom, longnose dace,*sensitive macros)
- Generalist (*e.g.* American Eel, Creek Chub, Sunfish)

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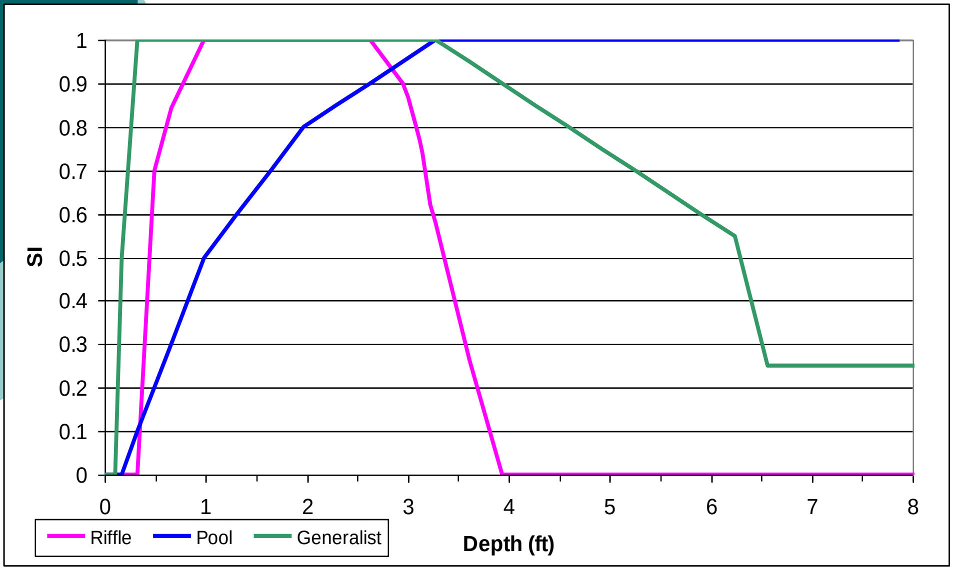
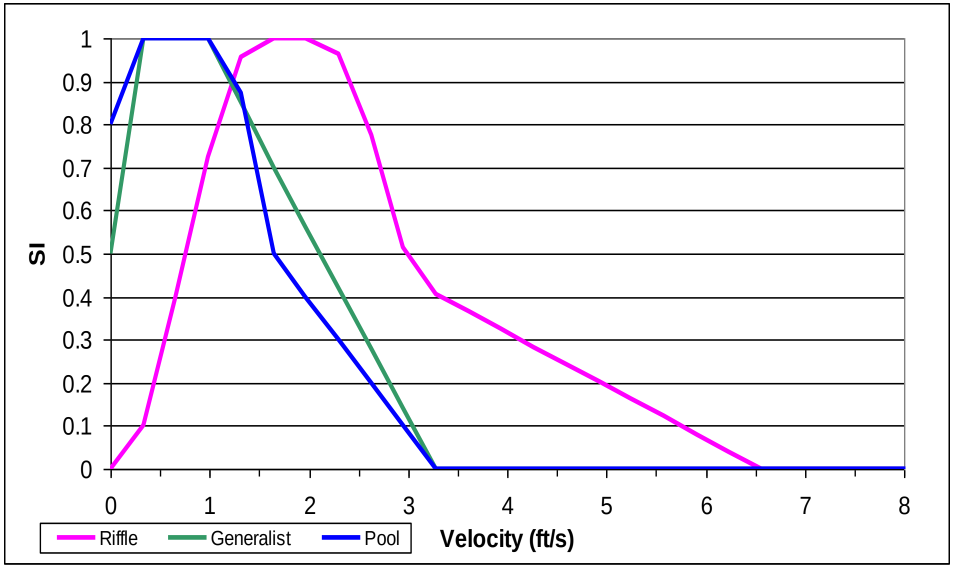
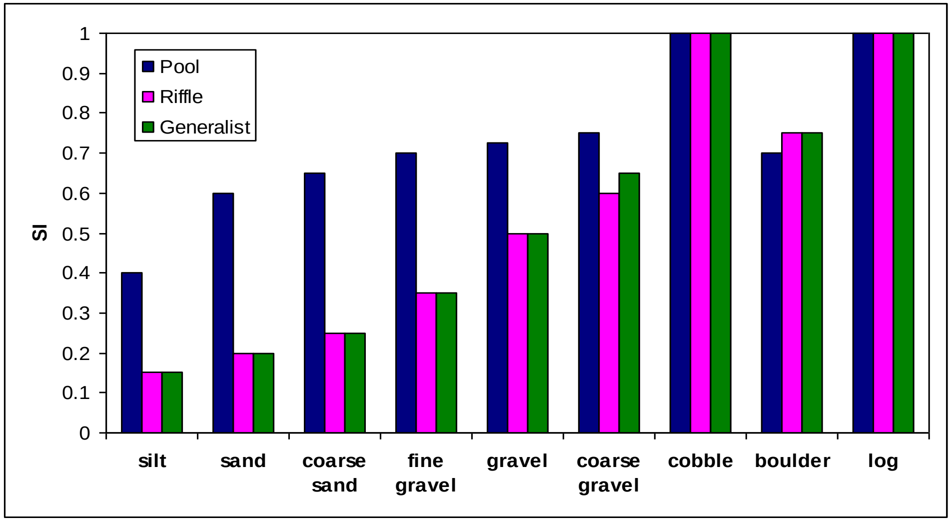
River2D Habitat Module







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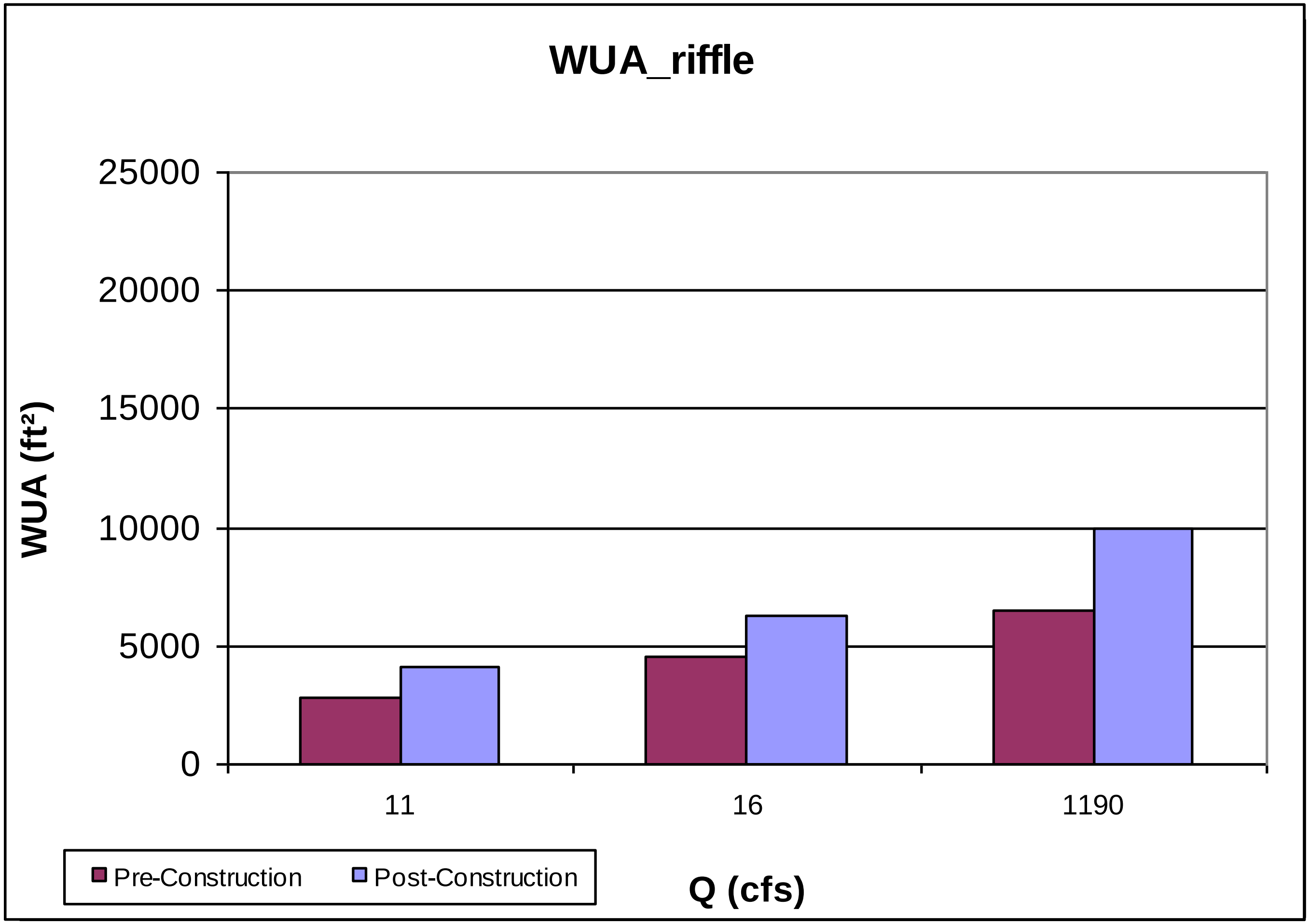
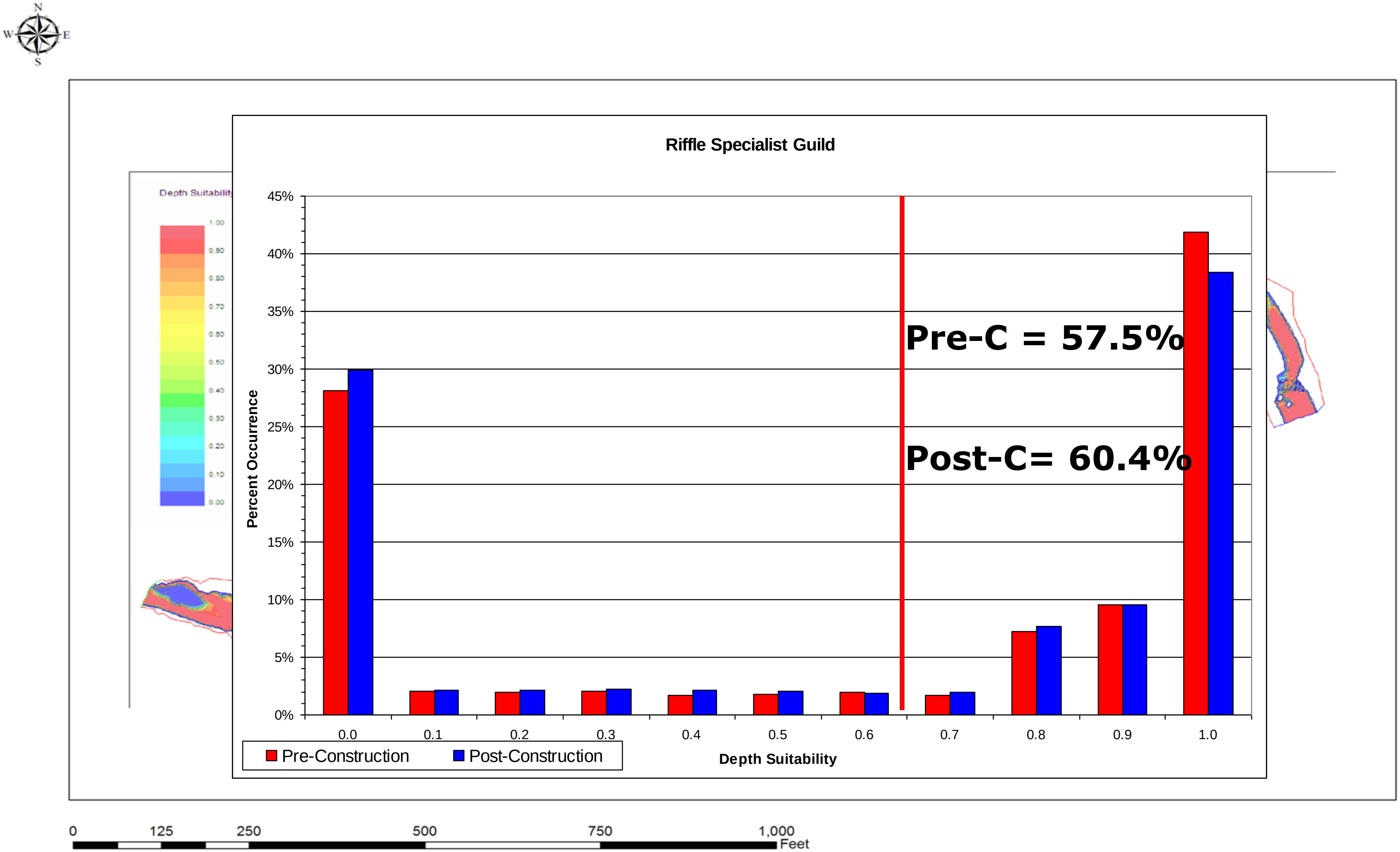
Habitat Analysis



R2D as Management Tool…



Closing the loop in Practice

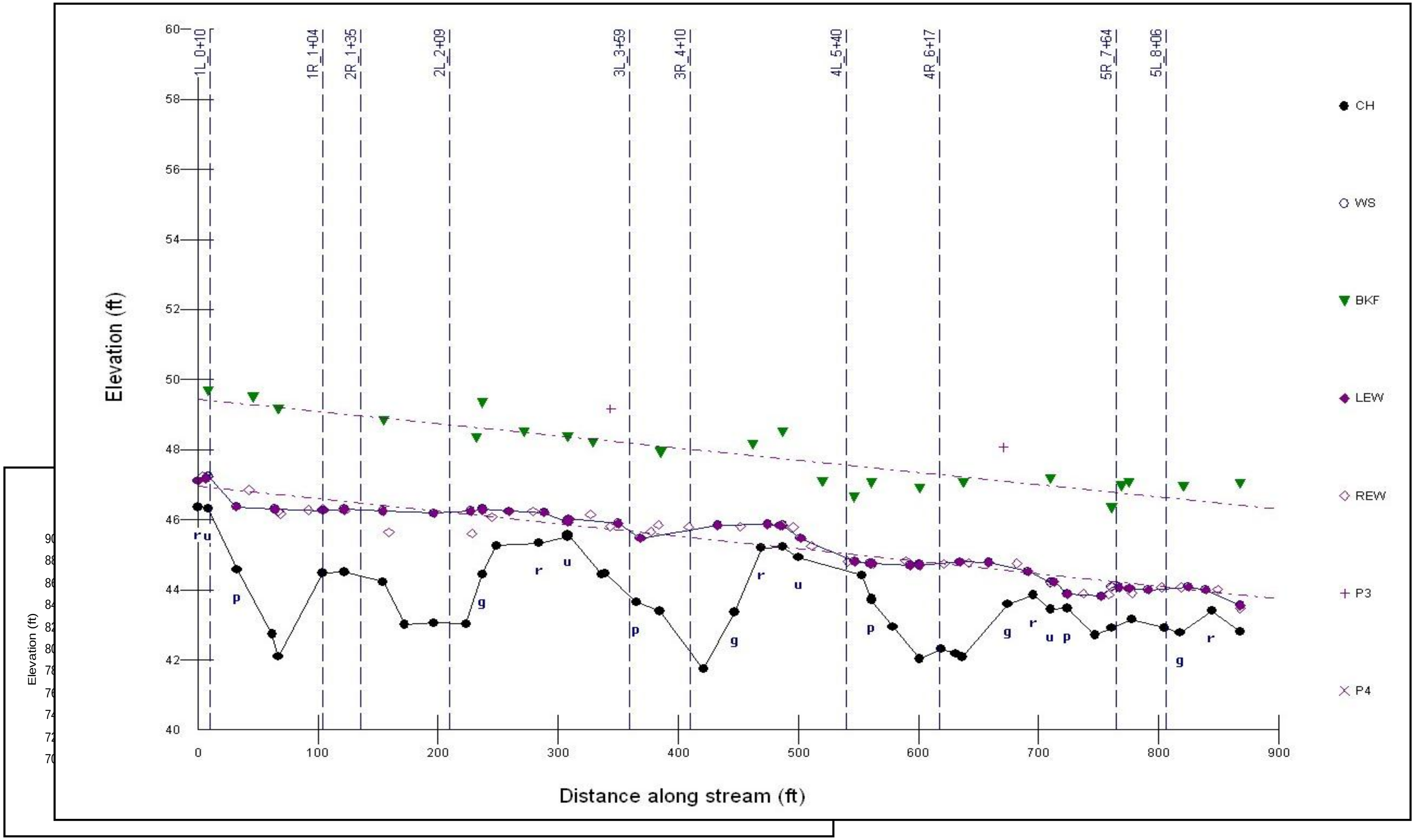
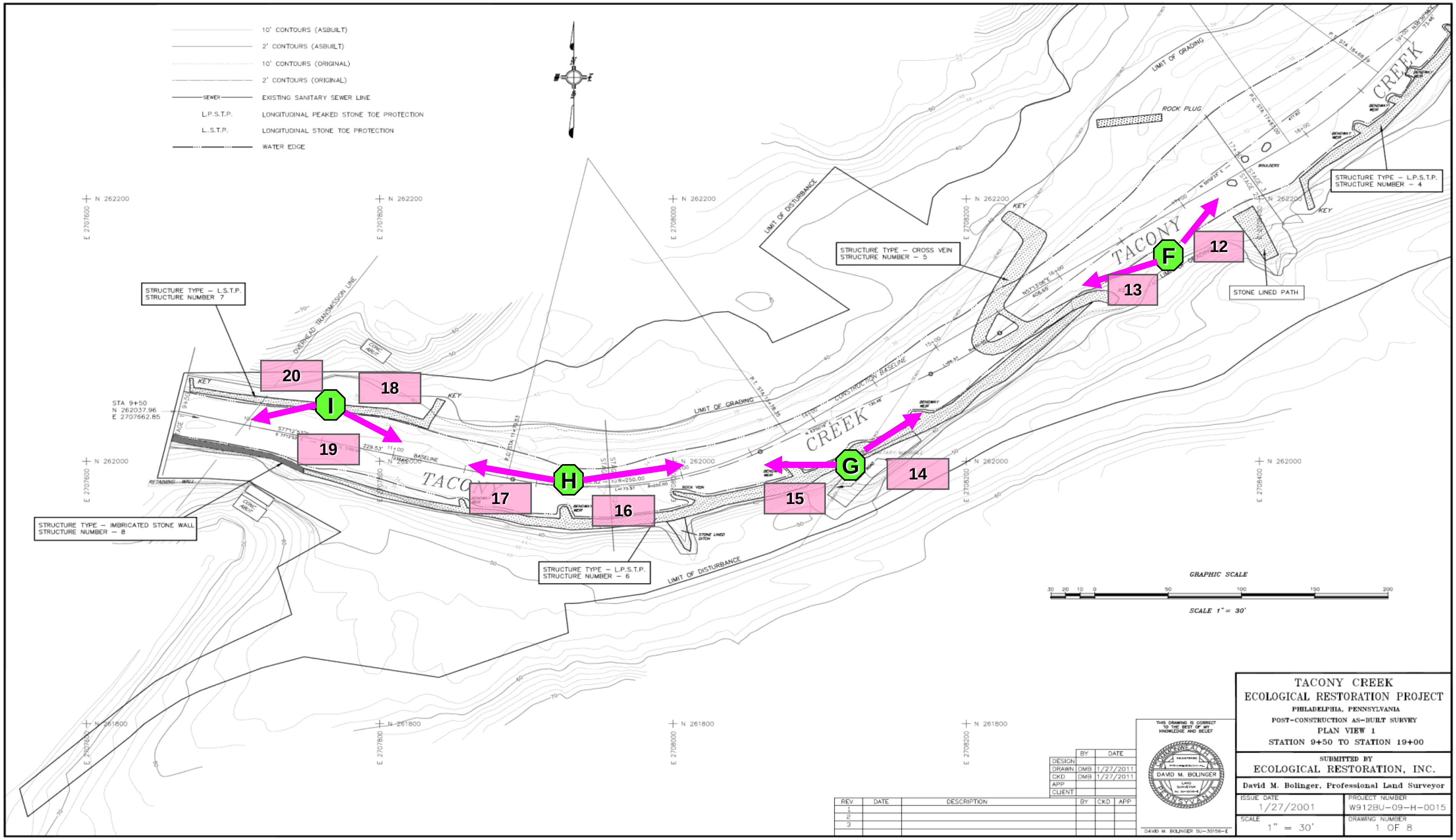
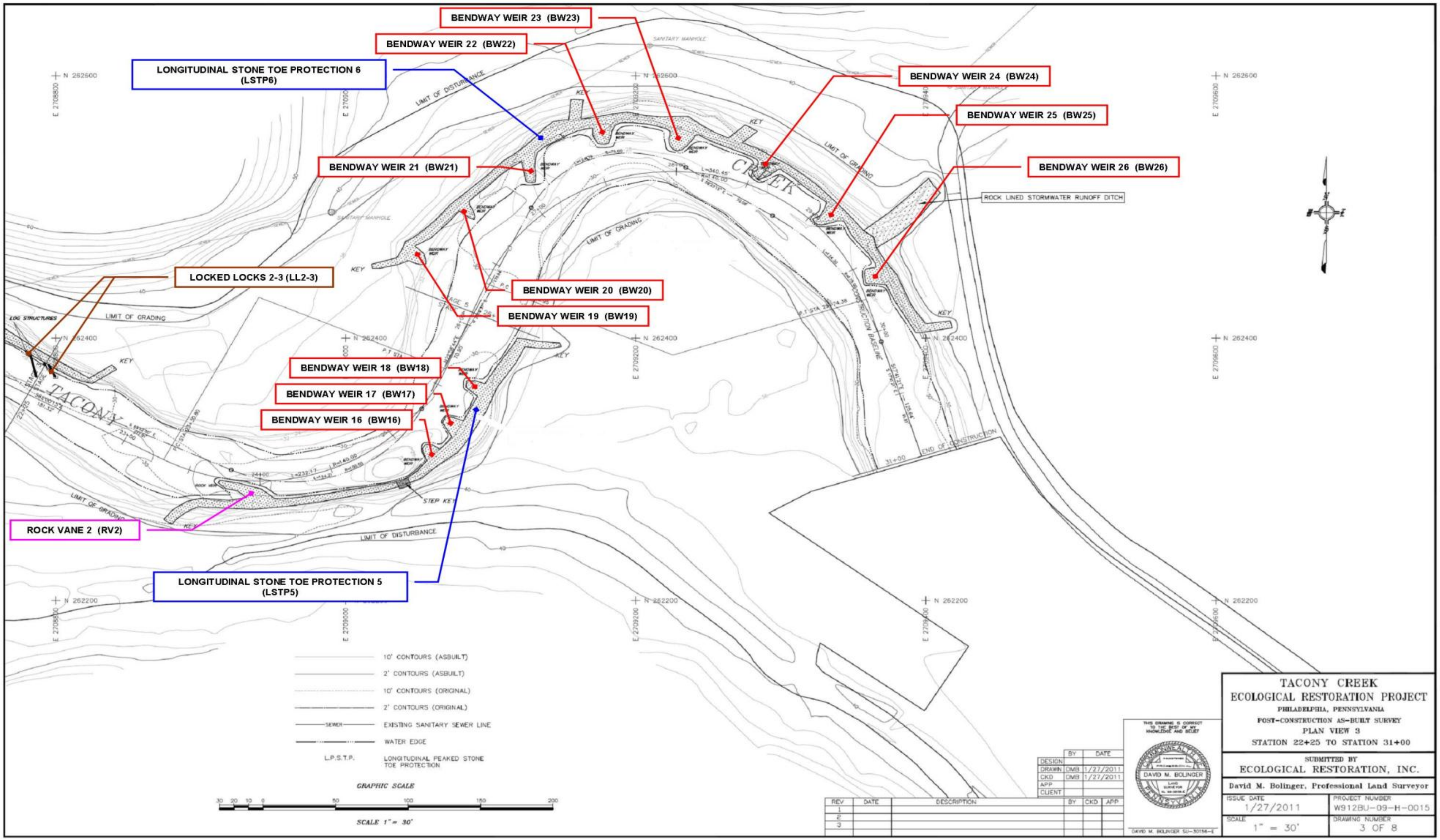


Photo-Monitoring

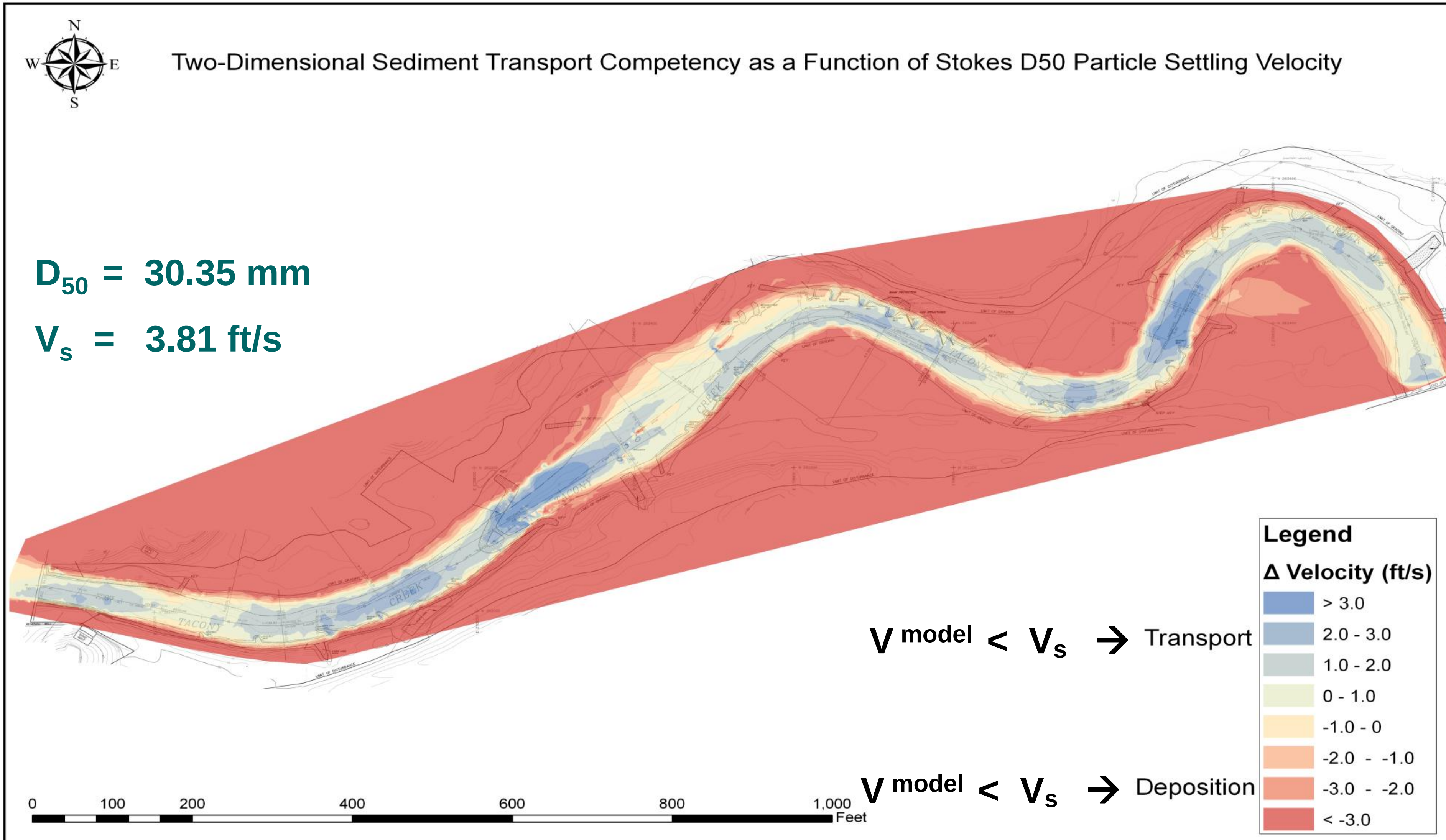


Instream Structure Monitoring



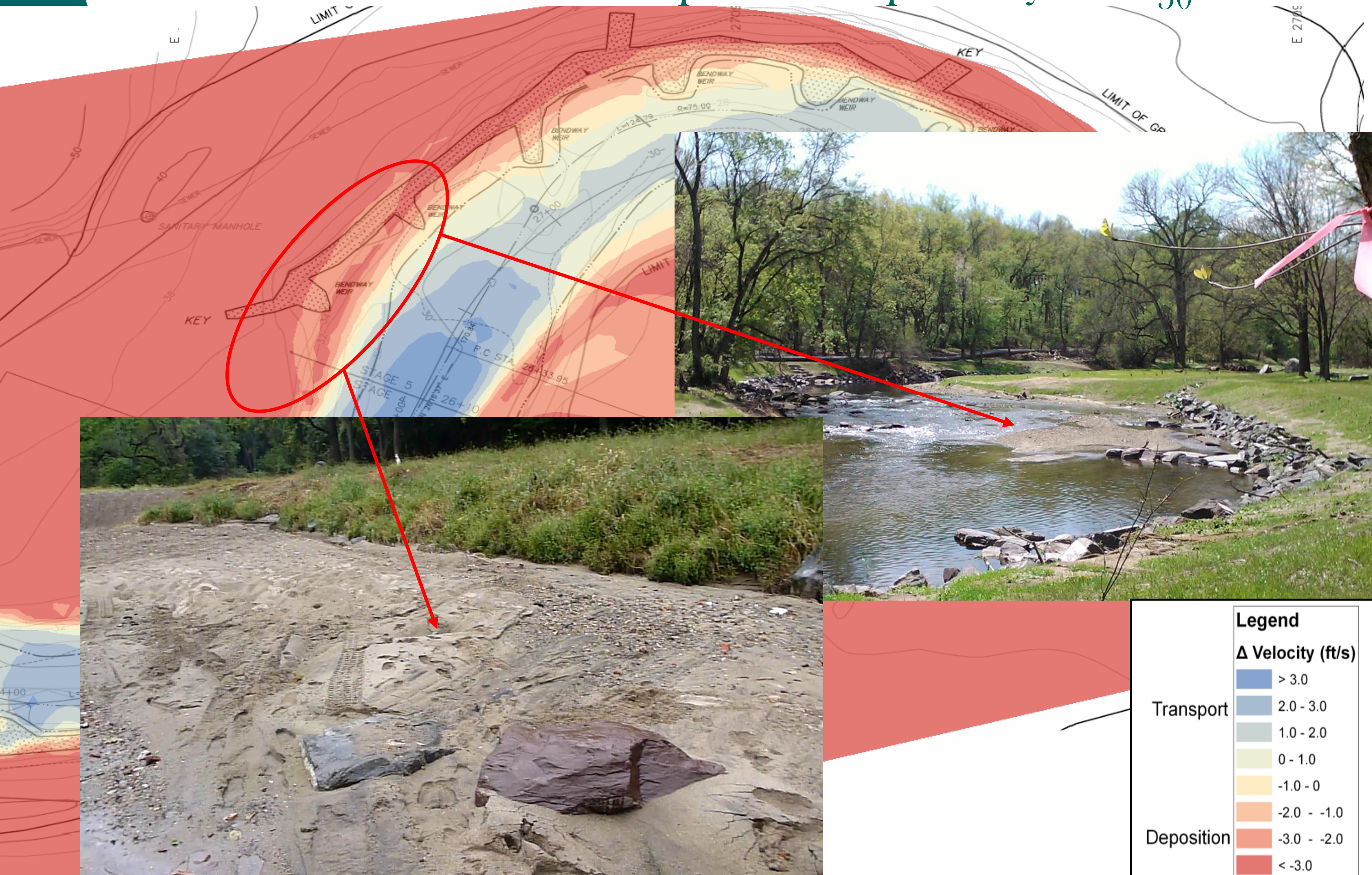
River2D Model Predictions :

Sediment Transport Competency of D_{50}

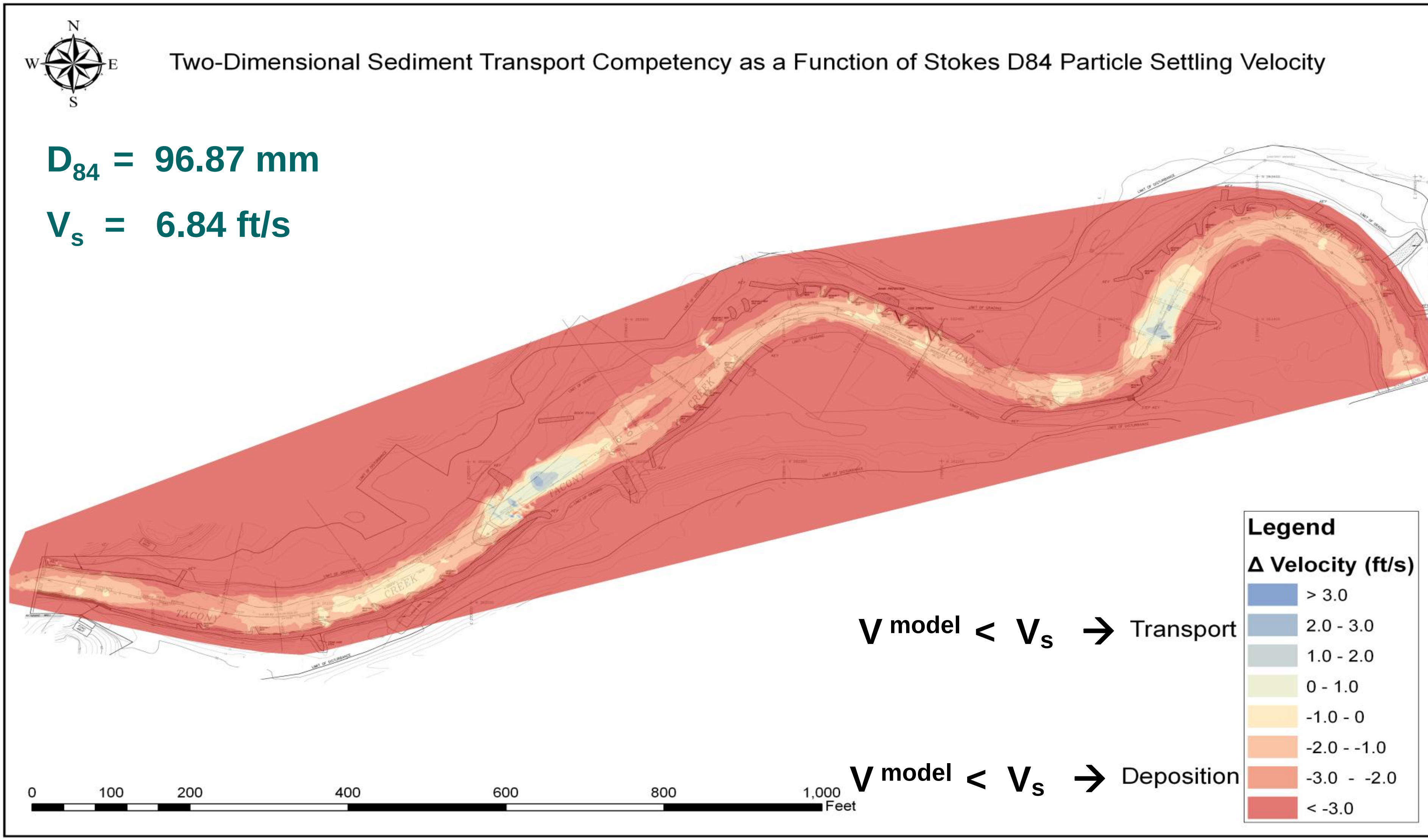


River2D Model Predictions:

Sediment Transport Competency of D_{50}

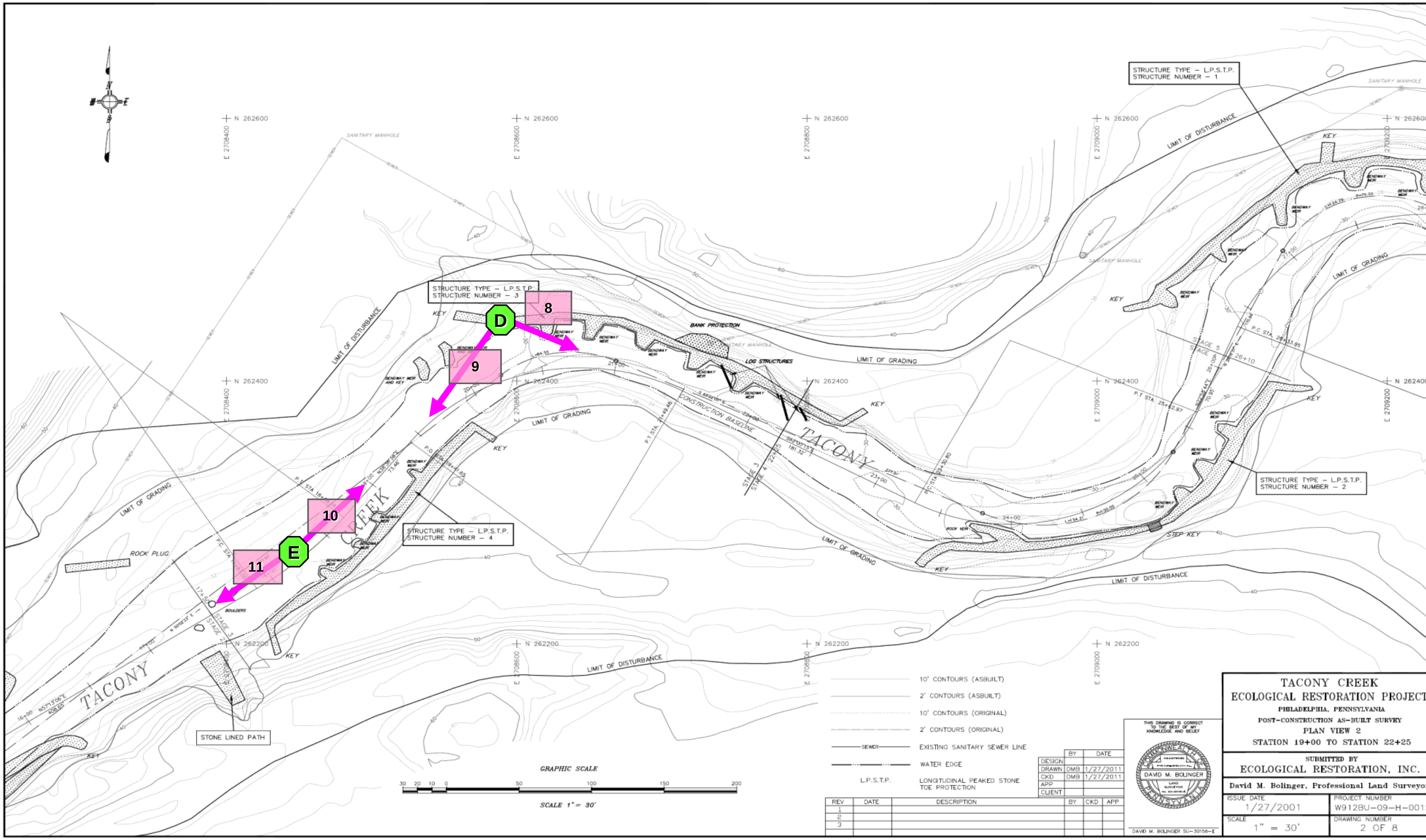


River2D Model Predictions :
Sediment Transport Competency of D_{84}

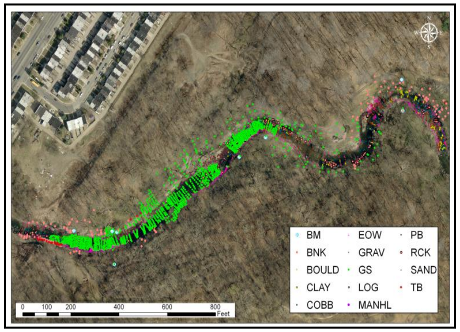


River2D Model Predictions :

Sediment Transport Competency of D_{84}

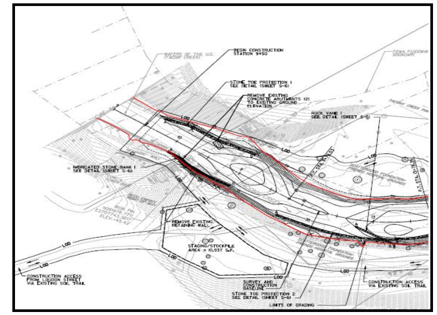


A New Paradigm….



Assessment

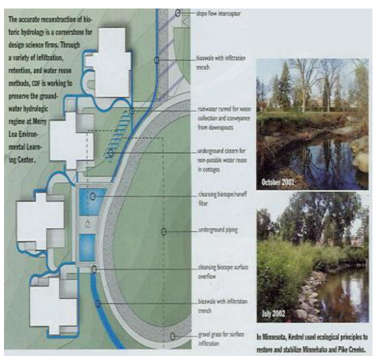
Design



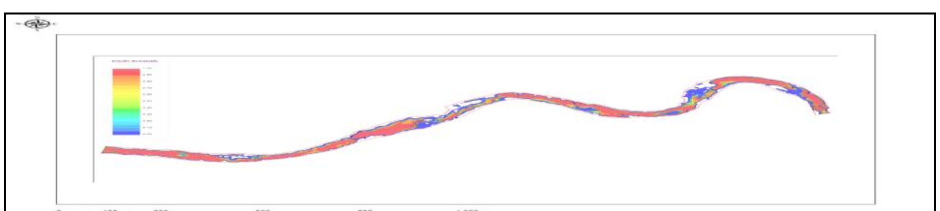
Construction

Best Management

Practices



Monitoring



For the future………

- Development of regional indices
  - Depth, velocity & substrate at fish sampling sites
- Other models..
  - River2D Morphology
- Tacony Creek Reaches 4-5

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Questions?